

39906098

HARDING-LAWSON ASSOCIATES

TA710.3
H3
H64
No. 652

FOUNDATION INVESTIGATION
WESTERN AIRLINES ALL-PURPOSE FACILITY
HONOLULU INTERNATIONAL AIRPORT
HONOLULU, OAHU, HAWAII

Job No. 3936,005.06

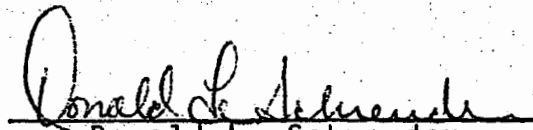
TMK: 1-1-03-85

Prepared for

The Ralph M. Parsons Company
550 Paiea Street
Honolulu, Hawaii 96820

by


James J. Stone
Project Manager


Donald L. Schreuder
Civil Engineer - 2531

Harding-Lawson Associates
1259 South Beretania Street
Honolulu, Hawaii 96814

February 29, 1975

MUNICIPAL REFERENCE & RECORDS CENTER

WITHDRAWN

City Hall, Room 4038, 5 King Street
Honolulu, Hawaii 96813

INTRODUCTION

This report presents the results of the foundation investigation we performed for the planned Western Airlines All-Purpose Facility at Honolulu International Airport. The site is located between Aolele Street and Aowena Way, just east of the Hawaiian Independent Refinery Terminal Site (Tax Map Key: 1-1-03: Por. 1).

The planned facility includes a high, one-story warehouse and attached 3-story office structure covering approximately 23,000 square feet and a vehicle maintenance operations structure covering approximately 11,000 square feet. The warehouse building will have a vehicle ramp for access to roof parking. A loading dock will be constructed along the north side. The vehicle maintenance building will enclose a high-capacity hydraulic hoist. Both buildings will have slab-on-grade floors. The remainder of the site outside of building areas will be paved for parking. Site grading includes fills up to 3 feet high and cuts up to 4 feet deep.

We understand that design column loads in the warehouse structure will be on the order of 310 kips for dead load and 100 kips for live load. Wall loads in the 3-story office portion will be on the order of 7.5 kips per linear foot dead load and 2 kips per linear foot live load. Structural loads for the maintenance building have not been determined. We anticipate that these will be relatively light.

The scope of our work was outlined in our proposal to Western Airlines, Incorporated dated October 22, 1974 and our Agreement for Services with the Ralph M. Parson's Company (No. 5436-SC-1) dated January 27, 1975. It included field exploration, laboratory testing and engineering analyses as a basis for developing

1. Recommendations for suitable foundation types for the structures and soil engineering criteria for foundation design
2. Estimates of foundation settlement behavior
3. Soil engineering criteria for design of the hydraulic lift foundation in the vehicle maintenance building
4. Recommendations for site preparation and grading
5. Recommendations for subgrade preparation beneath slab-on-grade floors
6. Asphalt concrete pavement sections for parking and apron areas.

Our work was coordinated with Mr. Les Calvert, Project Architect for the Ralph M. Parsons Company. During the course of our work, we discussed our preliminary conclusions and recommendations with Mr. Bernard Wong and Mr. Martin Rutter, also of the Ralph M. Parsons Company.

FIELD EXPLORATION AND LABORATORY TESTING

We explored subsurface conditions with nine test borings located as shown on the Site Plan, Plate 1. The borings were drilled to depths ranging from 9 to 40 feet with truck-mounted, continuous flight auger drilling equipment. Our field engineer logged the test borings and obtained core samples of the materials

encountered. The boring logs are presented on Plates 6 through 14. The soils are classified according to the Unified Soil Classification System which is explained on Plate 15. The rock is described in terms of its physical characteristics.

We reexamined the samples in our laboratory and selected representative samples for testing. The laboratory program included moisture content/dry density determinations and strength, consolidation, compaction and California Bearing Ratio (CBR) tests. The results of the moisture content/dry density determinations and strength tests are presented on the boring logs in the manner described in the Key to Test Data, Plate 15. The results of the consolidation test are presented on Plate 16. The results of the compaction and CBR tests are presented on Plates 17 and 18, respectively.

SITE AND SOIL CONDITIONS

The site is nearly level. The surface supports local grass and weed growth. Currently, the site is being used as a parking lot and storage area for equipment and materials used in the airport expansion. Construction debris is scattered along the east side.

The site is underlain by fill, silt, coral gravel, tuff and layered coral and alluvial soils. Subsurface profiles, indicating our interpretation of subsurface conditions at four locations on the site, are presented on Plates 2 through 5. A more complete description of each strata follows.

A. Fill

The fill is generally between one and 2-1/2 feet thick and consists of sand and gravel soils. The fill layer varies in strength and compressibility.

We obtained a topographic map dated February 15, 1956 from the Department of Transportation, Airports Division, which indicates that a drainage channel formerly crossed the site in an east-west direction. A tributary of the main channel extended into the northeast part of the site. The approximate limits of this channel are indicated on the Site Plan. The channel has been filled with sand, gravel and silt which is relatively weak and compressible. The bottom probably varies from 5 to 10 feet below the existing ground surface.

B. Silt Layer

The general site fill is underlain by a moderately compressible layer of clayey silt. The silt layer is up to three feet thick in the warehouse area and up to 6 feet thick in test boring 9, drilled in the planned parking area near the southeast corner of the site. The silt layer has a high potential for expansion (it will shrink or swell with changes in moisture content).

C. Coral Gravel

A layer of medium dense to dense coral gravel underlies the silt layer. The gravel layer ranges from 4 to 10 feet thick and is strong and relatively incompressible.

D. Deeper Strata

The gravel is underlain by tuff to depths of 8 to 22 feet below the ground surface. The tuff has low hardness and is friable and deeply weathered. The tuff is underlain by layers of stiff alluvial silt and dense coral sand and gravel to the depths explored (40 feet). These materials are strong and relatively incompressible. A layer of loose sand, approximately 3 feet thick, was encountered at a depth of 25 feet in Boring 1. This layer was not encountered in any of the other borings.

E. Ground Water

Ground water levels stabilized at Elevation +2 (Mean Sea Level Datum), 10 to 11 feet below the existing ground surface.

DISCUSSION AND CONCLUSIONS

The existing fill and silt soils will compress under the weight of the heavily loaded warehouse and ramp footings. Therefore,

these footings should bottom on the underlying relatively incompressible gravel, or the existing compressible soils should be excavated and replaced with compacted select fill. The influence of the relatively light loads imposed by footings in the equipment maintenance structure will not extend to a significant depth below the bottom of the footings. A layer of compacted select fill which extends to at least two feet below the footing bottoms will provide uniform support for spread footings in this area. Settlement of the buildings should be negligible.

We judge that the existing site fill, except backfill material in the old stream channel and organically contaminated surface soils, will be suitable for use as select fill. Material not suitable for use as select fill can be used as fill outside of building areas.

Excavation for the hydraulic lift pit in the equipment maintenance building should not encounter ground water or significant seepage unless it extends below about Elevation +2.5. If the drilled hole for the ram extends into sands and gravels below the water level, it will probably require casing.

RECOMMENDATIONS

Site Preparation

Areas to be graded should be stripped of grass, weeds and debris. The existing fill and the underlying silt layer should be excavated from the old drainage channel and from spread footing locations in the warehouse. Overexcavation should extend at least

five feet beyond the perimeter of footings. The existing fill should be excavated as necessary to provide at least two feet of compacted select fill below the bottom of footings in the equipment maintenance building.

The surface exposed by stripping or overexcavation should be scarified to a depth of 6 inches, moisture conditioned and compacted to 95 percent relative compaction.*

Compacted Fill

It is likely that the existing fill material will be suitable for reuse as select fill, with the possible exception of fill material in the old drainage channel and surface soils which contain organic debris. Except for soils containing organic debris, material which does not meet the requirements for select fill can be used as compacted fill outside of building areas and below the layer of select fill in paved areas. Select fill should conform to the following requirements:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
4 inches	100
1-1/2 inches	80 - 100
No. 4	40 - 80
No. 200	0 - 40
Plasticity Index	15 or less
Liquid Limit	35 or less
California Bearing Ratio . . .	60 minimum

* Relative compaction refers to the dry density of the compacted material expressed as a percentage of the maximum dry density of the same material as determined by the ASTM D1557-70(C) test procedure.

Fill material should be placed in lifts 8 inches or less in loose thickness, moisture conditioned to near optimum moisture** content and compacted to 95 percent relative compaction.

Foundation Support

Spread footings should be designed in accordance with the following limiting criteria

	<u>Maintenance Building - Footings Underlain By 2 Feet of Compacted Select Fill</u>	<u>Footings Bottomed On Compacted Select Fill Over Gravel, or on Dense Natural Gravel</u>
Allowable Bearing Pressure		
Dead plus long term live loads	2500 psf	4500 psf
Total of all loads, including wind or seismic	3000 psf	6000 psf
Resistance to Lateral Loads		
Friction Factor	0.4*	0.4*
Passive Earth Pressure	300 pcf**	300 pcf**

* Resistance to lateral loads along the base of footings should be computed by multiplying the friction factor by the downward dead load.

** Pounds per cubic foot equivalent fluid pressure. Passive earth pressure in the upper one foot of soil should be neglected unless the footing is confined by pavements or slabs.

Footings for walls should be at least 12 inches wide and isolated footings should be at least 18 inches in minimum dimension, regardless of load. Footings should bottom at least 12 inches below the lowest adjacent soil surface.

** Optimum moisture is that moisture content which corresponds to the maximum dry density as determined by the ASTM D1557-70(C) compaction test method.

The bottom of footing excavations in gravel should be compacted to at least 95 percent relative compaction with a vibratory compactor. The compacted layer should be at least six inches thick.

Retaining Walls

Retaining walls should be designed to support an equivalent fluid backfill pressure of 35 pounds per cubic foot. This value is for earth pressure only. Foundation, surcharge and traffic loads should be added where they are anticipated.

Soil backfill behind retaining walls should consist of select fill placed in thin lifts and compacted to 95 percent relative compaction. Weepholes should be provided at periodic intervals along the wall to relieve the buildup of hydrostatic pressure from the infiltration of surface water. About one cubic foot of free-draining crushed rock should be placed at the intake end of weepholes. Retaining wall footings should be designed in accordance with the above recommendations for spread footings.

Hydraulic Lift Foundation

The foundation for the hydraulic lift pit should bottom in the dense gravel layer or underlying tuff. The foundation should be designed according to the recommendations presented above for spread footings on gravel. Pit walls should be designed as retaining walls. Hydrostatic uplift on the foundation and hydrostatic pressure on the walls should be included if the pit extends below Elevation +2.5.

Slab-on-Grade Floors

At least 12 inches of select fill compacted to 95 percent relative compaction should be provided below the soil subgrade beneath slab-on-grade floors. The fill surface should be proof rolled. Slab-on-grade floors should be underlain by at least four inches of clean, free-draining crushed rock to provide uniform support for the slab and to serve as a break to the rise of capillary moisture. Where dampness in the floor slab would be undesirable, a suitable moisture vapor barrier should be installed.

Pavements

Based on the laboratory CBR test results, we recommend a pavement section of two inches of asphalt concrete over six inches of aggregate base for parking areas subject to automobile and light truck traffic only. The pavement section should be underlain by at least six inches of select fill compacted to 95 percent relative compaction.

We converted the CBR value obtained from our laboratory tests to an equivalent "R" (Resistance) value and developed recommendations for pavement design in areas subject to heavy tug traffic generally in accordance with Test Method No. California 301-F. Based on these procedures, we recommend a pavement section consisting of three inches of asphalt concrete over nine inches of aggregate base. The pavement section should be underlain by at least 12 inches of select fill compacted to at least 95 percent relative compaction.

CONSTRUCTION INSPECTION

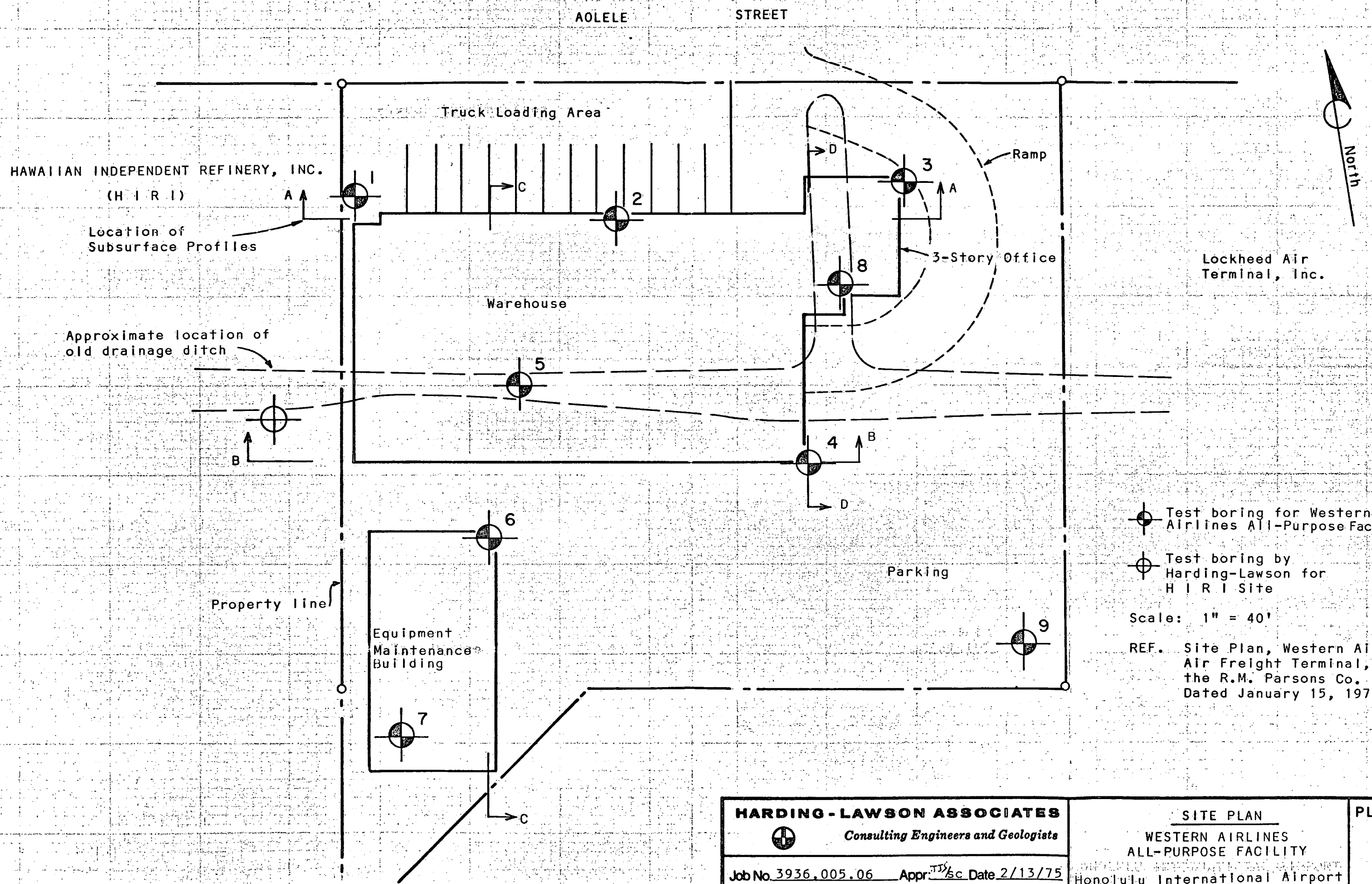
We should review the foundation and grading plans prior to construction. We will inspect and, if appropriate, test imported material to be used as select fill. We plan to observe site preparation, grading, placement and compaction of fills and backfills and foundation excavations. We will perform appropriate field testing to evaluate fill compaction. If unusual or unanticipated conditions are encountered during construction, we will be able to modify our recommendations or develop appropriate additional recommendations.

PLATES

Plate	1	Site Plan
Plate	2	Subsurface Profile
Plate	3	Subsurface Profile
Plate	4	Subsurface Profile
Plate	5	Subsurface Profile
Plates through	6 14	Logs of Boring 1 through 9
Plate	15	Soil Classification Chart and Key to Test Data
Plate	16	Consolidation Test Report
Plate	17	Compaction Test Data
Plate	18	California Bearing Ratio Test Data

DISTRIBUTION

5 copies: The Ralph M. Parsons Company
 550 Paiea Street
 Honolulu, Hawaii 96820



⊙ Test boring for Western Airlines All-Purpose Facility

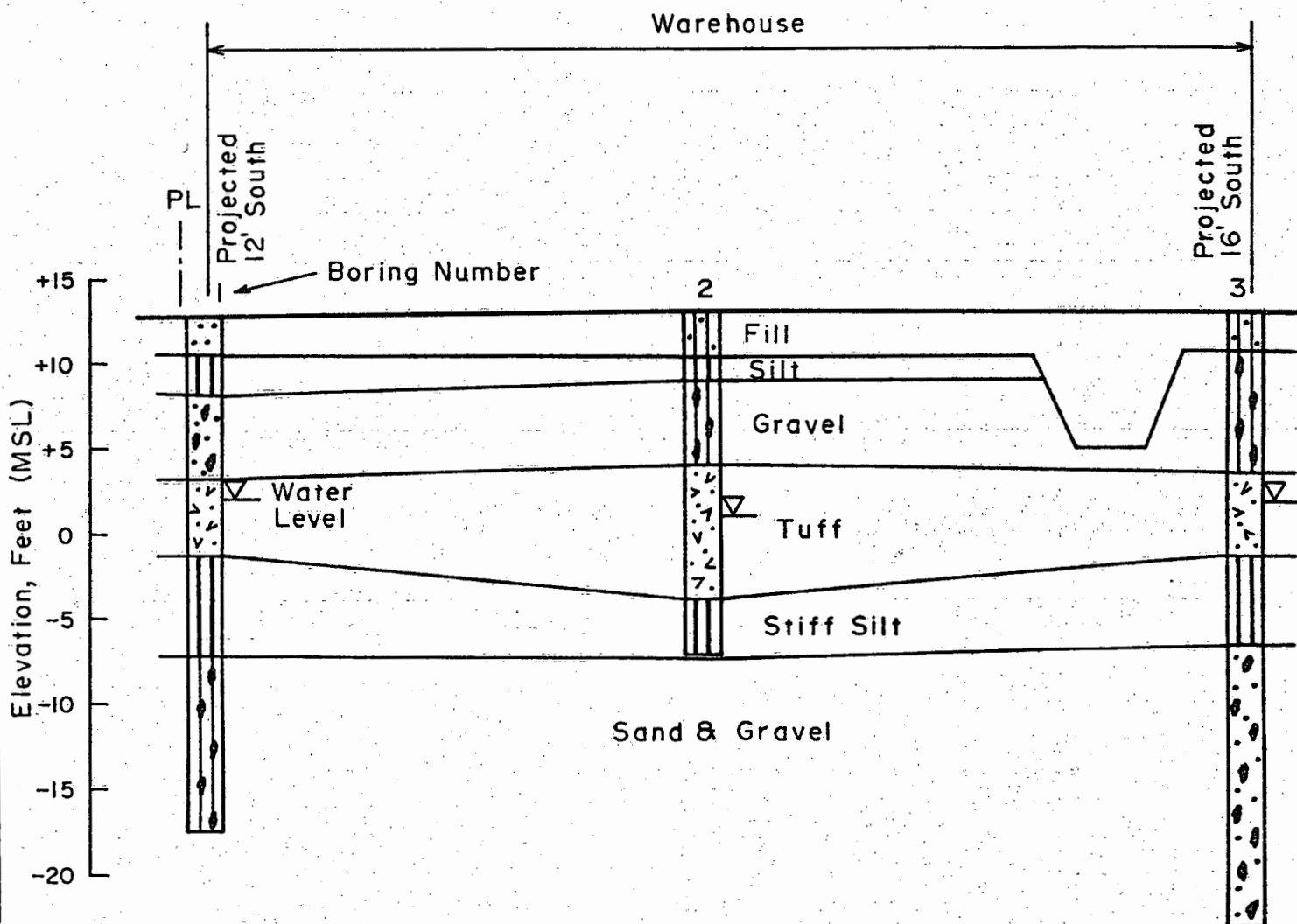
⊕ Test boring by Harding-Lawson for H I R I Site

Scale: 1" = 40'

REF. Site Plan, Western Airline Air Freight Terminal, by the R.M. Parsons Co. Dated January 15, 1975

HARDING - LAWSON ASSOCIATES	
Consulting Engineers and Geologists	
Job No. 3936.005.06 Appr. ^{JTS} /sc Date 2/13/75	

SITE PLAN	PLATE 1
WESTERN AIRLINES ALL-PURPOSE FACILITY	
Honolulu International Airport	



SECTION A-A

Scale: 1" = 40' Horiz.
1" = 10' Vert.

HARDING - LAWSON ASSOCIATES



Consulting Engineers and Geologists

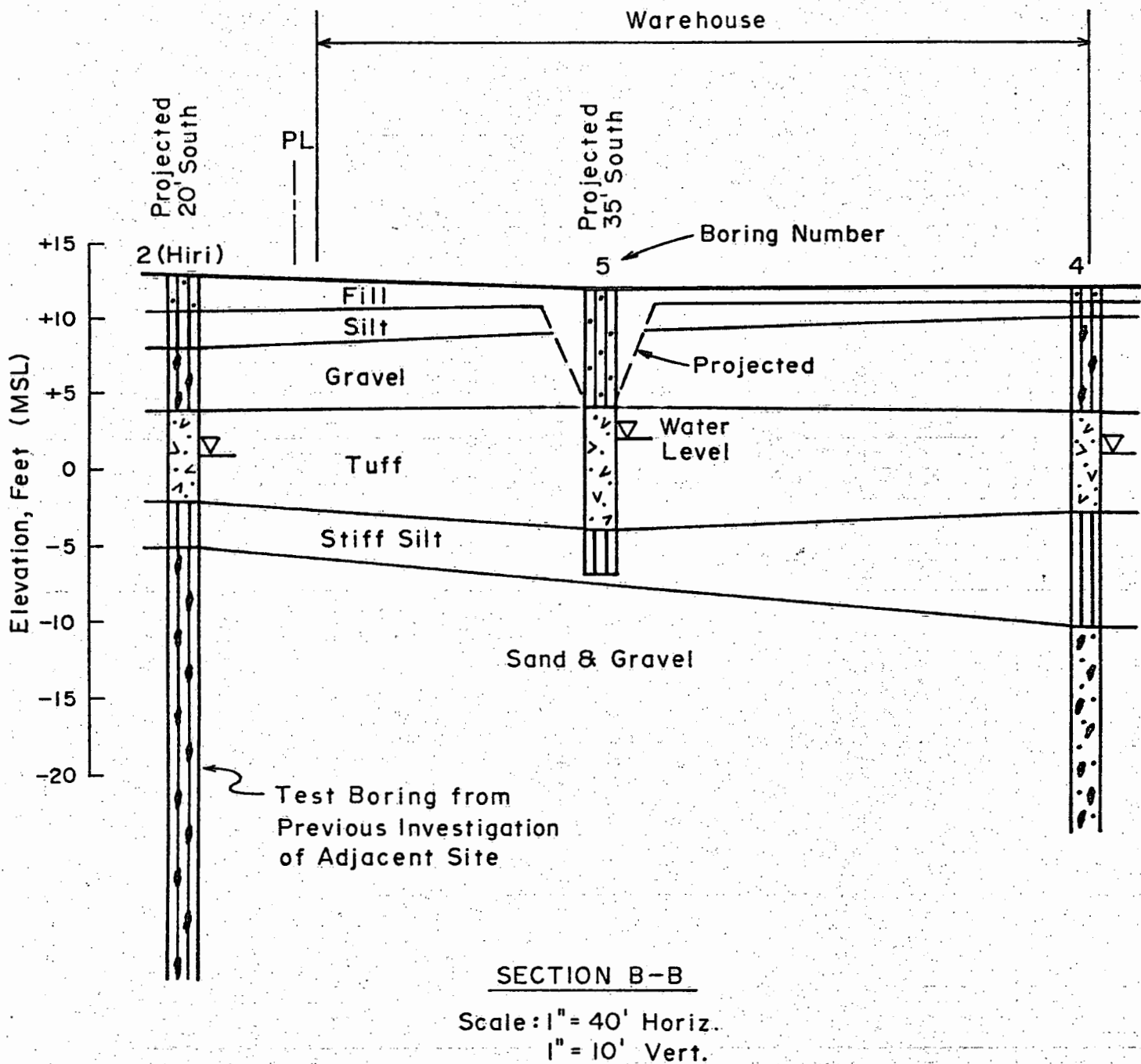
Job No. 3936.005.06 Appr. JSS Date 2/18/75

SUBSURFACE PROFILE

WESTERN AIRLINES
ALL-PURPOSE FACILITY
Honolulu International Airport

PLATE

2



HARDING - LAWSON ASSOCIATES



Consulting Engineers and Geologists

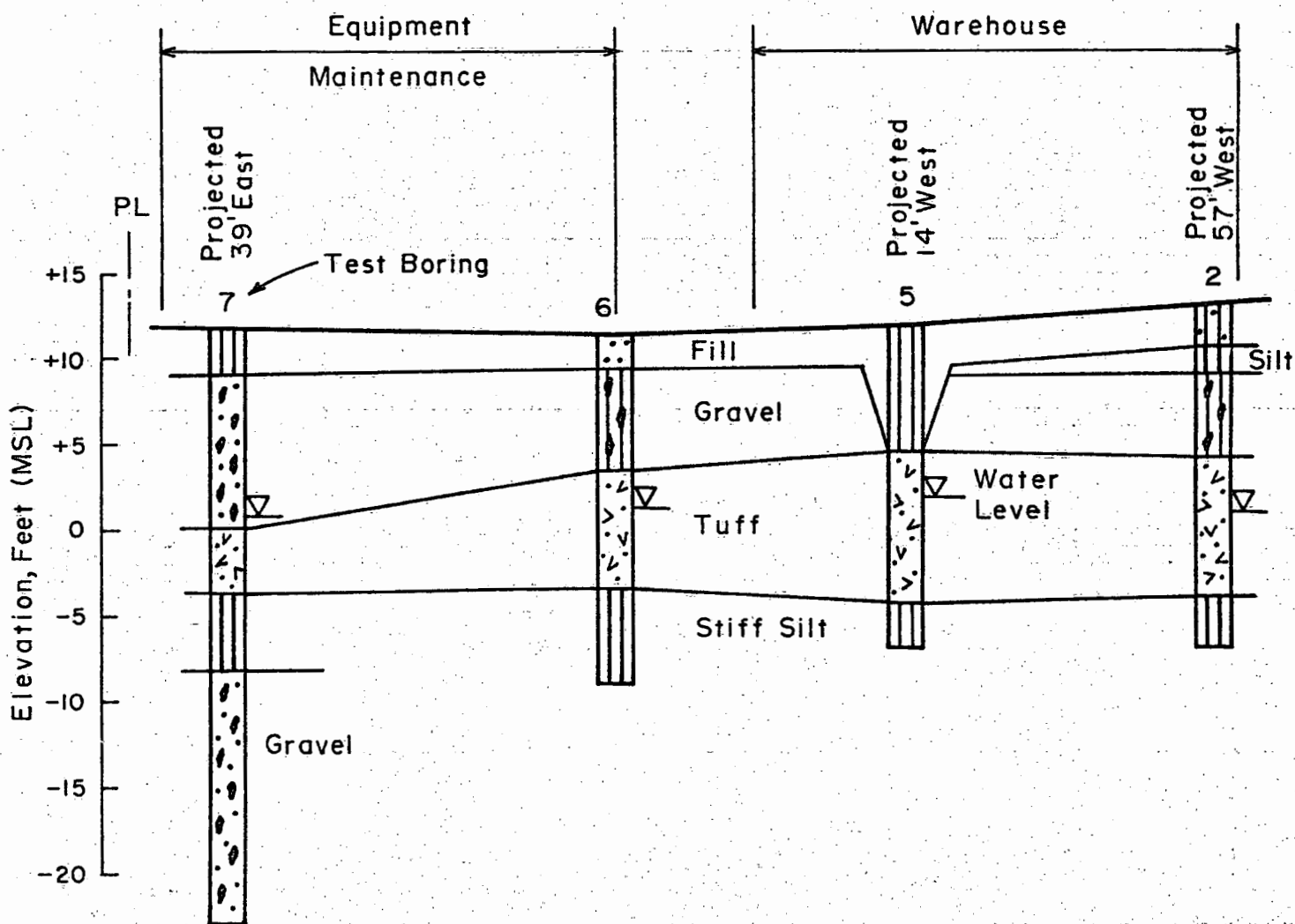
Job No. 3936.005.06 Appr. J.J.S. Date 2/18/75

SUBSURFACE PROFILE

WESTERN AIRLINES
ALL-PURPOSE FACILITY
Honolulu International Airport

PLATE

3



SECTION C-C

Scale: 1" = 40' Horiz.
1" = 10' Vert.

HARDING - LAWSON ASSOCIATES



Consulting Engineers and Geologists

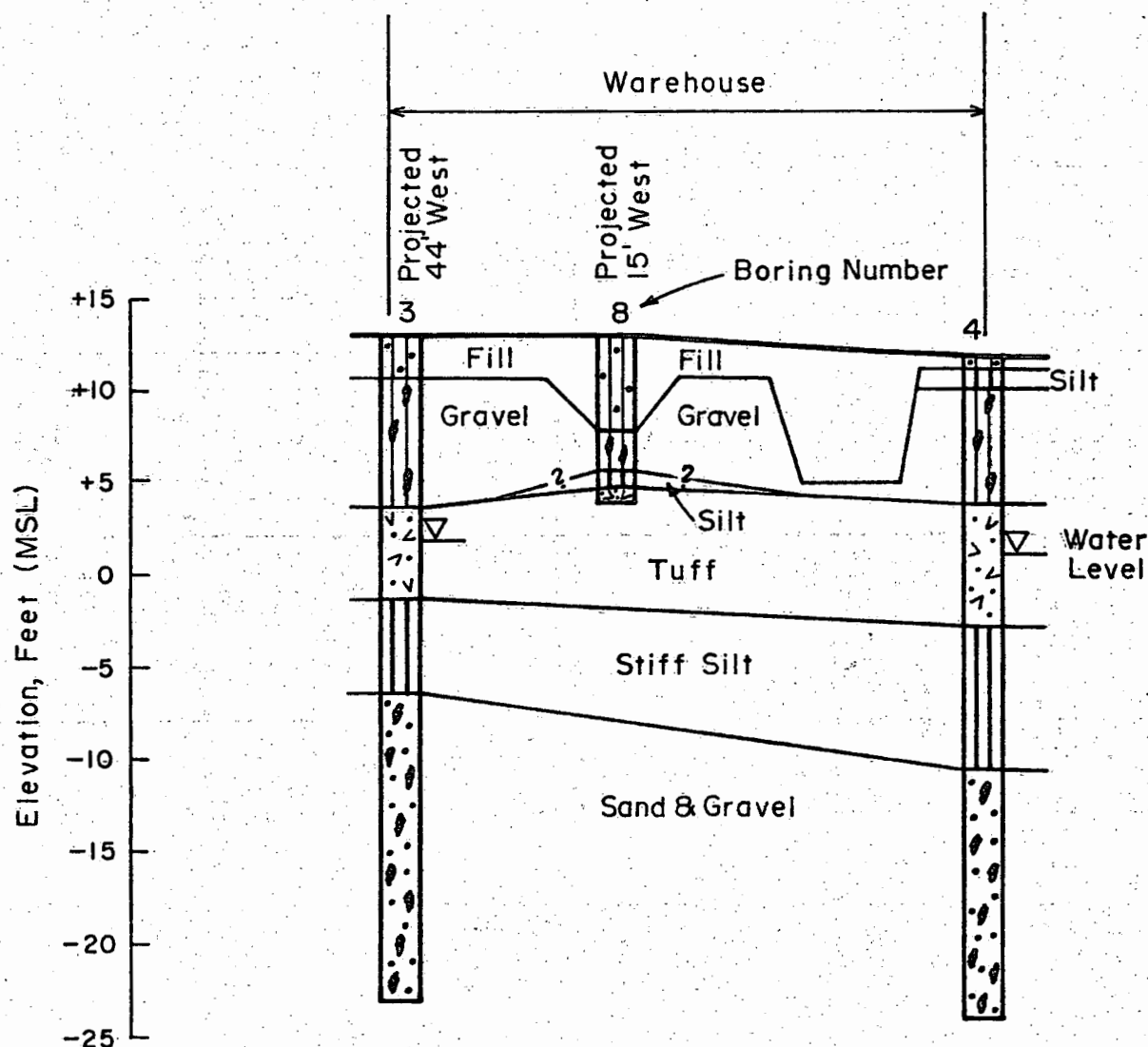
Job No. 3936.005.06 Appr. J.J.S. Date 2/18/75

SUBSURFACE PROFILE

WESTERN AIRLINES
ALL-PURPOSE FACILITY
Honolulu International Airport

PLATE

4



SECTION D-D

Scale: 1" = 40' Horiz.
1" = 10' Vert.

HARDING - LAWSON ASSOCIATES



Consulting Engineers and Geologists

Job No. 3936.005.06 Appr. JJS Date 2/18/75

SUBSURFACE PROFILE

**WESTERN AIRLINES
ALL-PURPOSE FACILITY
Honolulu International Airport**

PLATE

5

RFL7

LOG OF BORING I

Equipment 4" Flight Auger

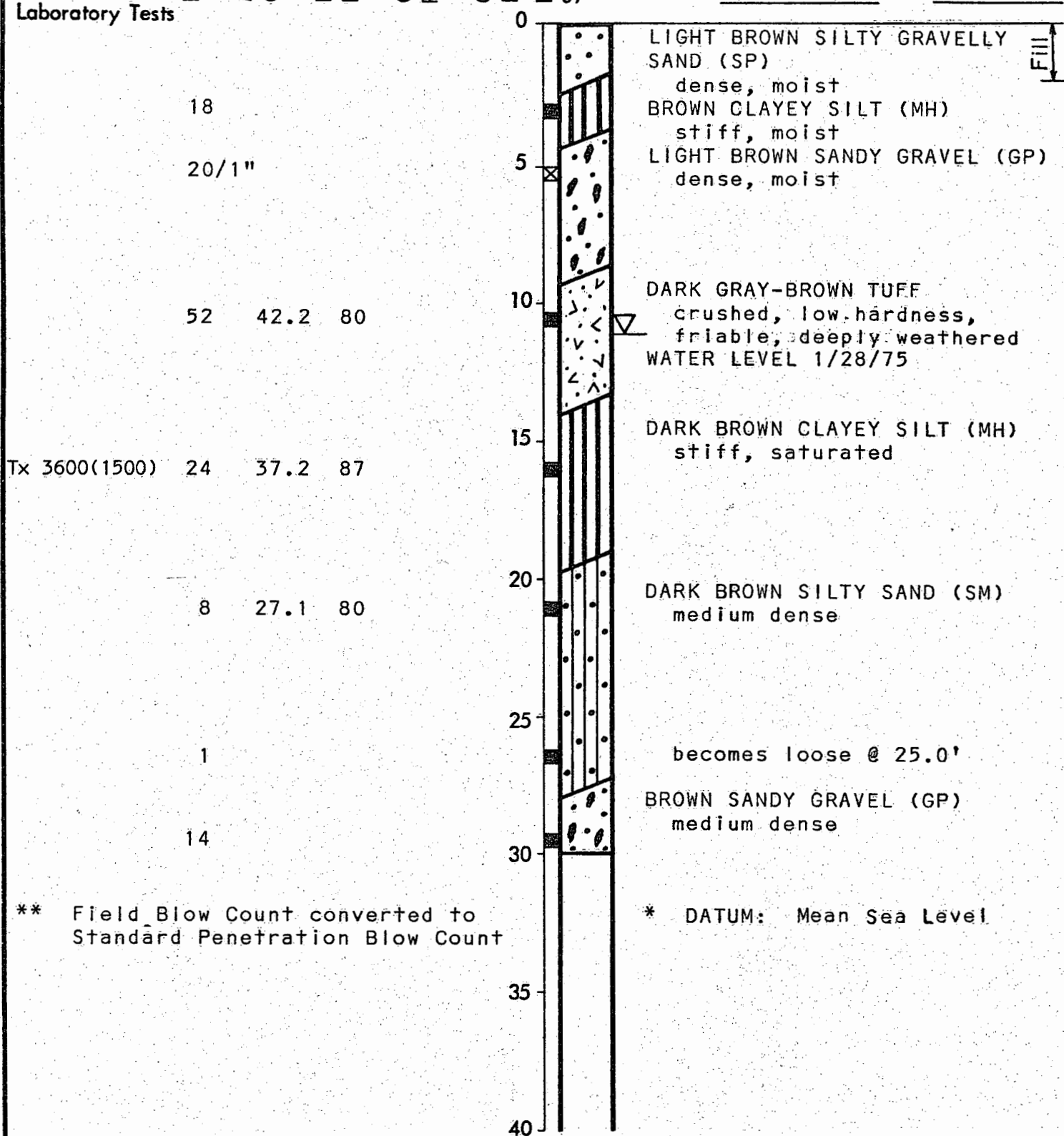
Elevation 12.9'*

Date 1/27/75

Laboratory Tests

Blows/foot **
Moisture Content (%)
Dry Density (pcf)
Core Recovery (%)

Cored Interval
Depth (ft)
Sample



HARDING - LAWSON ASSOCIATES



Consulting Engineers and Geologists

LOG OF BORING I

WESTERN AIRLINES
ALL-PURPOSE FACILITY

Job No. 3936,005.06 Appr: JS/sc Date 2/18/75

Honolulu International Airport

PLATE

6

LOG OF BORING 2

Equipment 4" Flight Auger

Elevation 13.1'

Date 1/29/75

Laboratory Tests

Blows/foot
Moisture Content (%)
Dry Density (pcf)
Core Recovery (%)

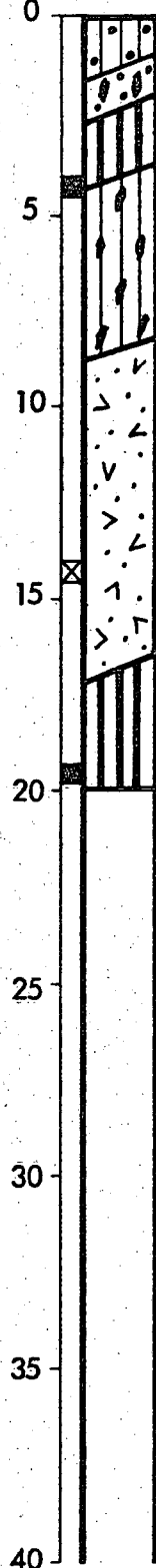
Cored Interval
Depth (ft)
Sample

Tx 2000(1000) 34 17.8 104

34/4"

23/1"

31



LIGHT BROWN SILTY SAND (SM)

medium dense, moist

DARK GRAY SANDY GRAVEL (GP)

medium dense, moist

BROWN CLAYEY SILT (MH)

stiff, moist

LIGHT BROWN SANDY GRAVEL

(GM)

dense, moist

DARK GRAY-BROWN TUFF

crushed, low hardness,

friable, deeply weathered

WATER LEVEL 1/29/75

DARK BROWN CLAYEY SILT (MH)

stiff, saturated

HARDING - LAWSON ASSOCIATES



Consulting Engineers and Geologists

LOG OF BORING 2

WESTERN AIRLINES
ALL-PURPOSE FACILITY

Job No. 3936,005.06 Appr: JJS Date 2/20/75

Honolulu International Airport

PLATE

7

LOG OF BORING 3

Equipment 4" Flight Auger
Elevation 13.0' Date 1/28/75

Laboratory Tests

Blows/foot
Moisture Content (%)
Dry Density (pcf)
Core Recovery (%)

Cored Interval
Depth (ft)
Sample

Tx 2114(1000) 19 26.5 96

27/8"

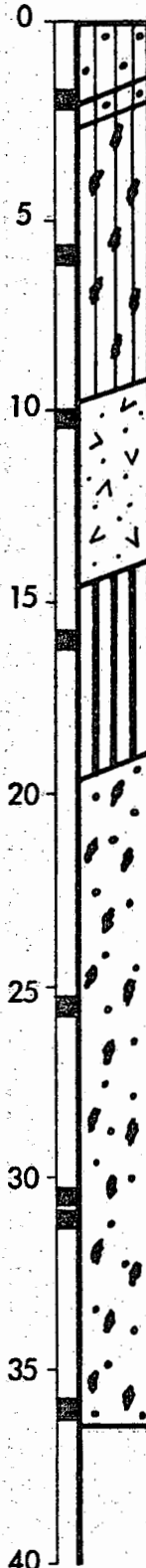
34

10/1"

27

35

11



LIGHT BROWN SAND (SM)
medium dense, moist
BLACK SILTY SAND (SM)
loose, wet
LIGHT BROWN SILTY GRAVEL
(GM)
medium dense, moist

Fill

DARK GRAY-BROWN TUFF
crushed, low hardness,
friable, deeply weathered
WATER LEVEL 1/28/75

DARK BROWN CLAYEY SILT (MH)
stiff, saturated

LIGHT BROWN SANDY GRAVEL
(GP)
dense

becomes medium dense
at 35.0'

HARDING - LAWSON ASSOCIATES



Consulting Engineers and Geologists

LOG OF BORING 3

WESTERN AIRLINES
ALL-PURPOSE FACILITY

Honolulu International Airport

Job No. 3936,005.06 Appr. JJS/sc Date 2/20/75

PLATE

8

LOG OF BORING 4

Equipment 4" Flight Auger

Elevation 12.0'

Date 1/31/75

Laboratory Tests

Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	Cored Interval	Depth (ft)	Sample	
				0			LIGHT BROWN SILTY GRAVELLY SAND (SM) medium dense, moist
14							BROWN CLAYEY SILT (MH) stiff, moist
				5			LIGHT BROWN SILTY GRAVEL dense, moist
Tx 3463(1000)	35	17.8	111				
37				10			DARK GRAY TUFF crushed, low hardness, friable, deeply weathered
							WATER LEVEL 1/29/75
				15			DARK BROWN CLAYEY SILT (MH) stiff, saturated
27	49.5	78		20			
							LIGHT BROWN SANDY GRAVEL (GP) medium dense
14				25			
21/5"				30			becomes dense @ 29.0'
44	19.1	105		35			
24				40			

HARDING - LAWSON ASSOCIATES



Consulting Engineers and Geologists

LOG OF BORING 4

WESTERN AIRLINES

ALL-PURPOSE FACILITY

Honolulu International Airport

PLATE

9

Job No. 3936,005.06 Appr. JJS Date 2/20/75

LOG OF BORING 5

Equipment 4" Flight Auger

Elevation 12.0'

Date 1/29/75

Laboratory Tests

Tx 1575(1000) 5 21.1 88

9 21.1 92

29

32/2"

29

Blows/foot
Moisture
Content (%)
Dry
Density (pcf)
Core
Recovery (%)
Cored
Interval
Depth (ft)
Sample

0

5

10

15

20

25

30

35

40

BROWN SANDY SILT (ML)
medium stiff, moist, with
occasional gravel

DARK GRAY-BROWN TUFF
crushed, low hardness,
friable, deeply weathered
WATER LEVEL 1/29/75

DARK BROWN SANDY SILT (ML)
stiff, saturated

Fill

HARDING - LAWSON ASSOCIATES



Consulting Engineers and Geologists

Job No. 3936,005.06 Appr: sc Date 2/20/75

LOG OF BORING 5

WESTERN AIRLINES
ALL-PURPOSE FACILITY

Honolulu International Airport

PLATE

10

RPL7

LOG OF BORING 6

Equipment 4" Flight Auger
Elevation 11.5' Date 1/28/75

Laboratory Tests

Tx 2200(1000) 33/7" 8.4 95

8/1"

19/3"

23 37.4 87

18/3"

Cored
Interval
Depth (ft)
Sample

0

5

10

15

20

25

30

35

40

LIGHT BROWN SANDY GRAVEL (GP)

dense, moist

LIGHT BROWN SILTY SANDY GRAVEL (GM)

dense, moist

DARK GRAY-BROWN TUFF

crushed, low hardness,
friable, deeply weathered
WATER LEVEL 1/28/75

DARK BROWN CLAYEY SILT (MH)
stiff, saturated

contains some gravel @ 20.0'

Fill

HARDING-LAWSON ASSOCIATES



Consulting Engineers and Geologists

Job No. 3936,005.06 Appr: JSC Date 2/20/75

LOG OF BORING 6

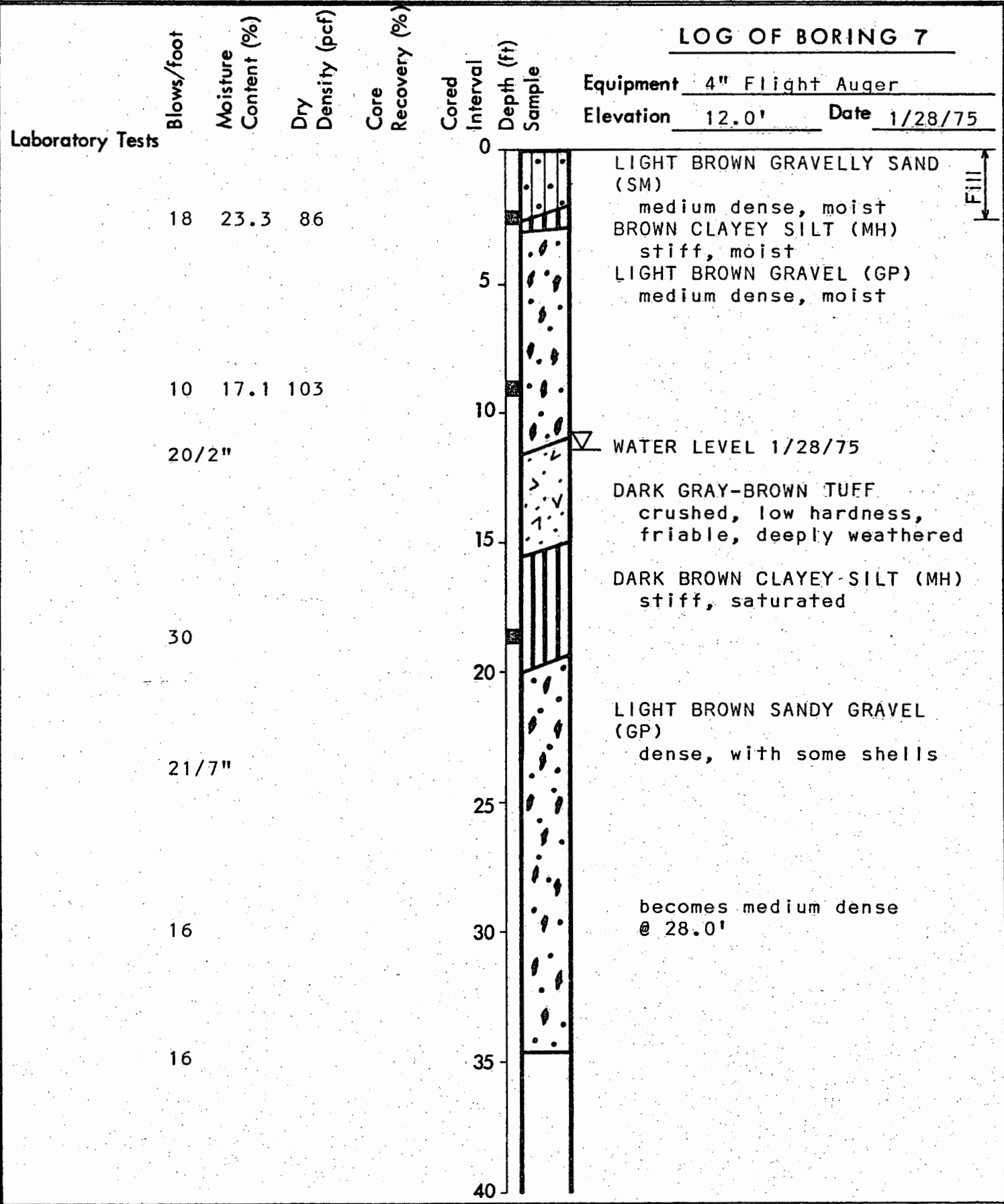
WESTERN AIRLINES
ALL-PURPOSE FACILITY

Honolulu International Airport

PLATE

11

RF-17



RFL7

LOG OF BORING 8

Equipment 4" Flight Auger
Elevation 12.9' Date 1/31/75

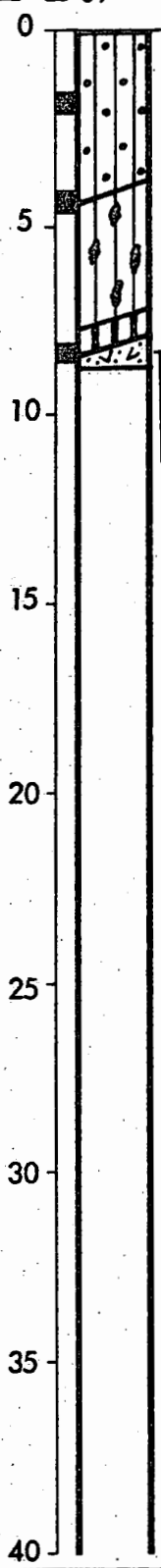
Laboratory Tests

Blows/foot
Moisture Content (%)
Dry Density (pcf)
Core Recovery (%)
Cored Interval
Depth (ft)
Sample

12

6 37.8 74

23/6"



DARK GRAY SILTY SAND (SM)
medium dense, moist

LIGHT BROWN SILTY GRAVEL
(GM)
medium dense, moist

DARK GRAY-BROWN CLAYEY SILT
(MH)
medium stiff, moist, with
coral gravel

DARK GRAY-BROWN TUFF
crushed, low hardness,
friable, deeply weathered

No Free Water Encountered

HARDING - LAWSON ASSOCIATES

Consulting Engineers and Geologists

LOG OF BORING 8
WESTERN AIRLINES
ALL-PURPOSE FACILITY

PLATE
13

Job No. 3936,005.06 Appr. JJS & C Date 2/20/75

Honolulu International Airport

LOG OF BORING 9

Equipment 4" Flight Auger

Elevation 11.3'

Date 1/31/75

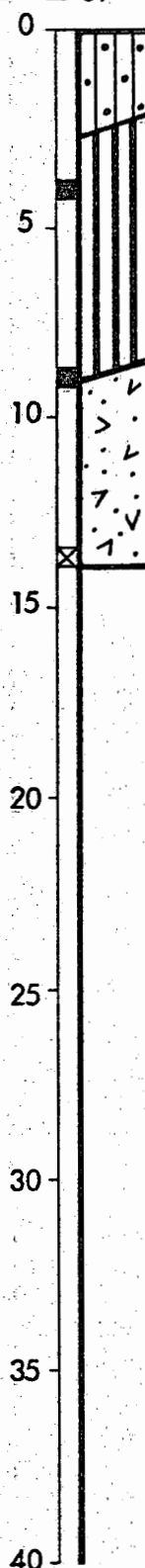
Laboratory Tests

Shrink- 6 46.7 76
Swell Test
Consolidation Test

25

23/3"

Cored Interval
Depth (ft)
Sample



LIGHT BROWN SILTY GRAVELLY SAND (SM)

medium dense, moist
BROWN CLAYEY SILT (MH)
medium stiff, wet

DARK GRAY-BROWN TUFF

crushed, low hardness,
friable, deeply weathered
WATER LEVEL 1/31/75

HARDING - LAWSON ASSOCIATES



Consulting Engineers and Geologists

LOG OF BORING 9

WESTERN AIRLINES
ALL-PURPOSE FACILITY

Job No. 3936,005.06 Appr. JJS Date 2/20/75



Honolulu International Airport

PLATE

14

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS MORE THAN HALF IS LARGER THAN #200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL - SAND - CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND - SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN HALF IS SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
		OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	
		CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
	HIGHLY ORGANIC SOILS		PT	PEAT AND OTHER HIGHLY ORGANIC SOILS

UNIFIED SOIL CLASSIFICATION SYSTEM

		Shear Strength, psf		Confining Pressure, psf	
Consol — Consolidation		*Tx	320 (2600)	Unconsolidated Undrained Triaxial	
LL — Liquid Limit (in %)		TxCU	320 (2600)	Consolidated Undrained Triaxial	
PL — Plastic Limit (in %)		DS	2750 (2000)	Consolidated Drained Direct Shear	
G _s — Specific Gravity		FVS	470	Field Vane Shear	
SA — Sieve Analysis		*UC	2000	Unconfined Compression	
 "Undisturbed" Sample		LVS	700	Laboratory Vane Shear	
 Bulk Sample					

Notes: (1) All strength tests on 2.8" or 2.4" diameter samples unless otherwise indicated.

(2) * Indicates 1.4" diameter sample.

KEY TO TEST DATA

HARDING - LAWSON ASSOCIATES



Consulting Engineers and Geologists

Job No. 3936,005.06 Appr. ^{JS}/sc Date 3/8/75

SOIL CLASSIFICATION CHART

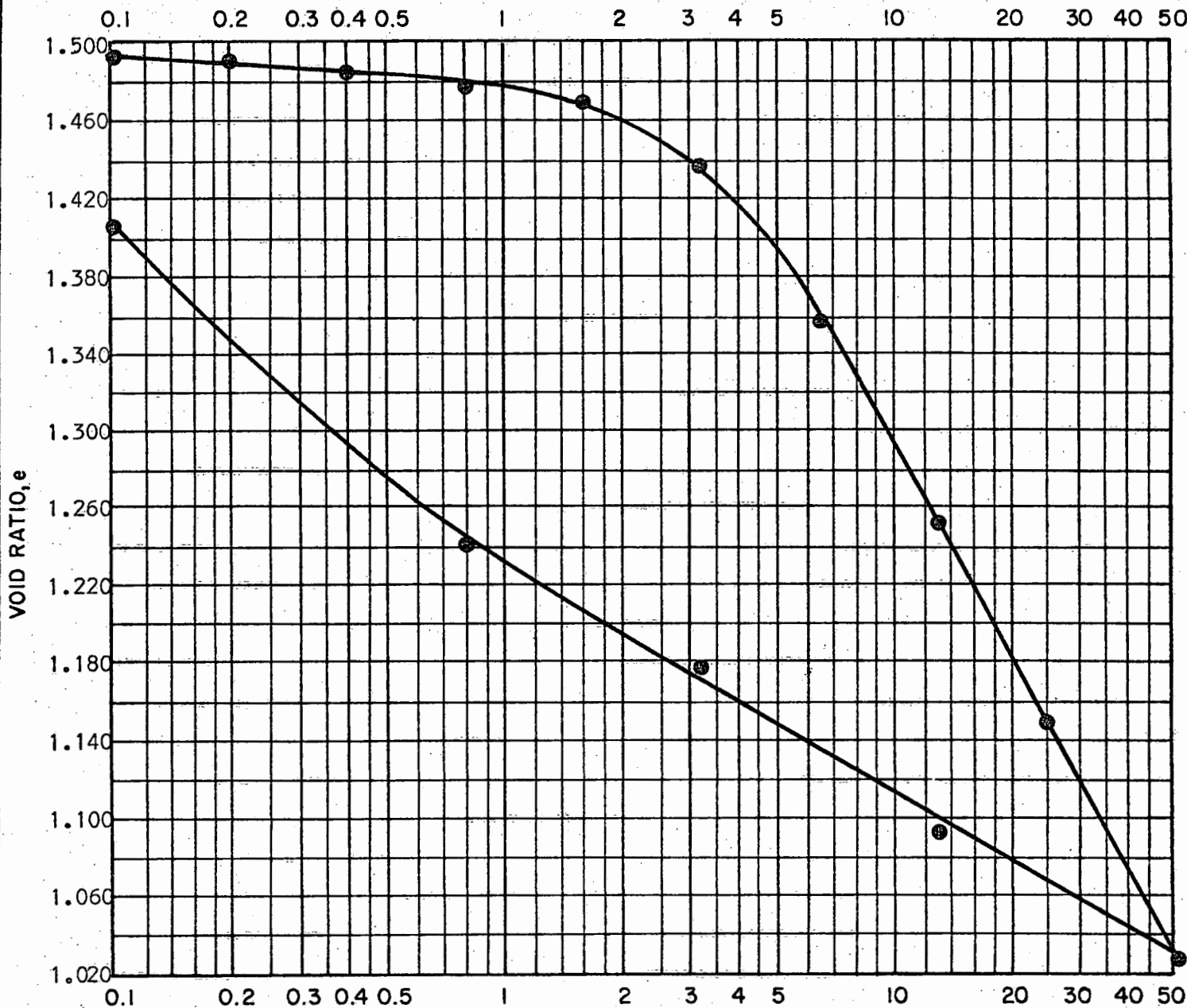
**AND
KEY TO TEST DATA**

WESTERN AIRLINES

PLATE

15

PRESSURE (psf x 1000)



TYPE OF SPECIMEN Undisturbed		BEFORE TEST			AFTER TEST		
DIAMETER (in.) 2.43	HEIGHT (in.) 0.80	MOISTURE CONTENT	w _o	46.7 %	w _f	45.0 %	
OVERBURDEN PRESS. P _o	400 psf	VOID RATIO	e _o	1.540	e _f	1.408	
PRECONSOL. PRESS. P _c	4000 psf	SATURATION	S _o	94 %	S _f	100 %	
COMPRESSION INDEX, C _c	0.372	DRY DENSITY	γ _d	76 pcf	γ _d	80 pcf	
LL	PL	PI	G _s Assumed 3.10				
CLASSIFICATION LIGHT BROWN CLAYEY SILT (MH)				SOURCE Boring 9 @ 3.8'			

HARDING - LAWSON ASSOCIATES



Consulting Engineers and Geologists

CONSOLIDATION TEST REPORT

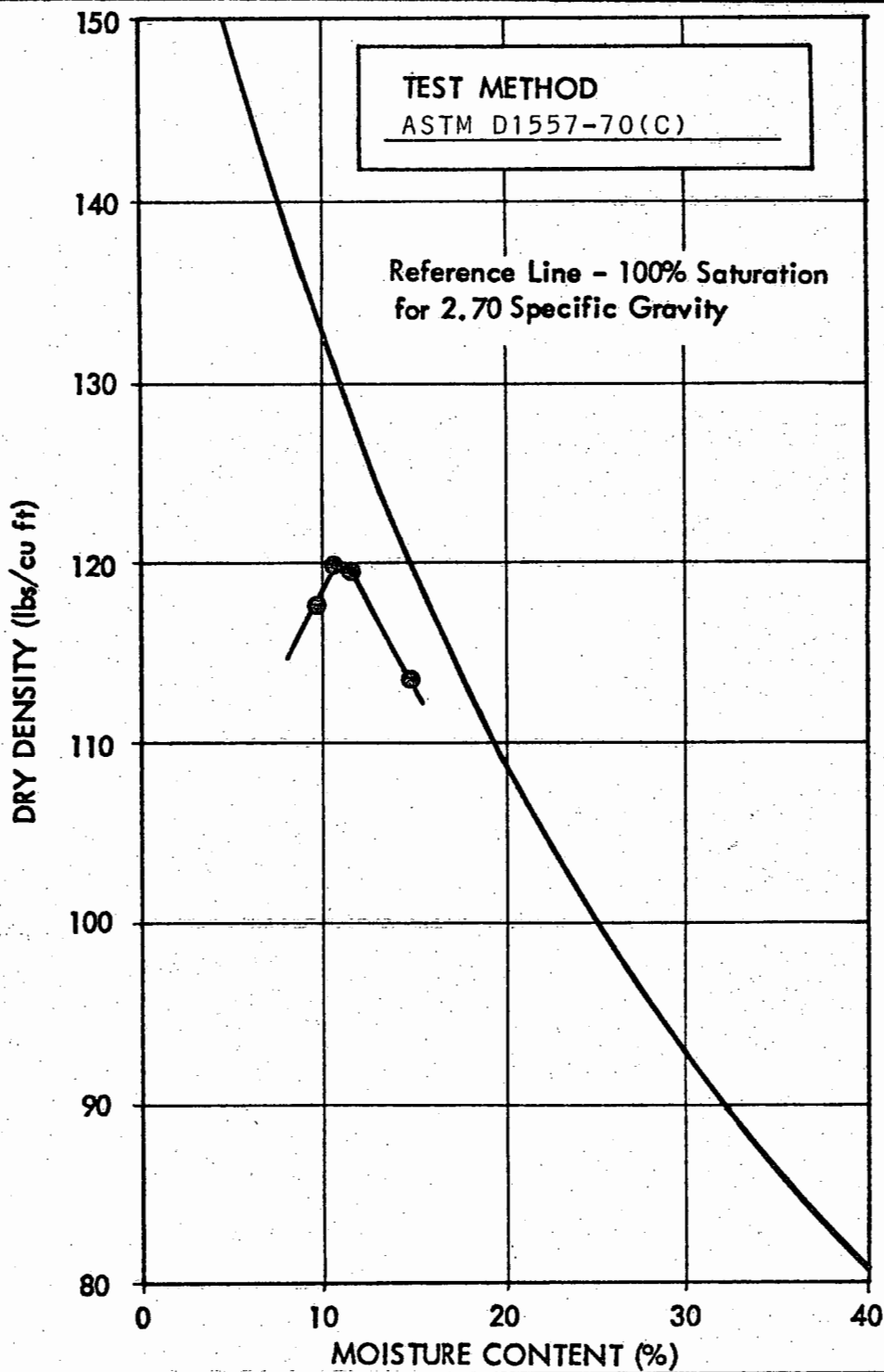
WESTERN AIRLINES
ALL-PURPOSE FACILITY

PLATE

16

Job No. 3936,005.06 Appr. JSC Date 2/26/75

Honolulu International Airport



Symbol	Sample Source	Classification	Optimum Moisture (%)	Maximum Dry Density (pcf)
●	Bulk A; Boring 4 0.0 - 2.0'	LIGHT BROWN SILTY GRAVELLY SAND (SM)	11.0	120

HARDING - LAWSON ASSOCIATES



Consulting Engineers and Geologists

Job No. 3936,005.06 Appr: JJS Date 2/26/75

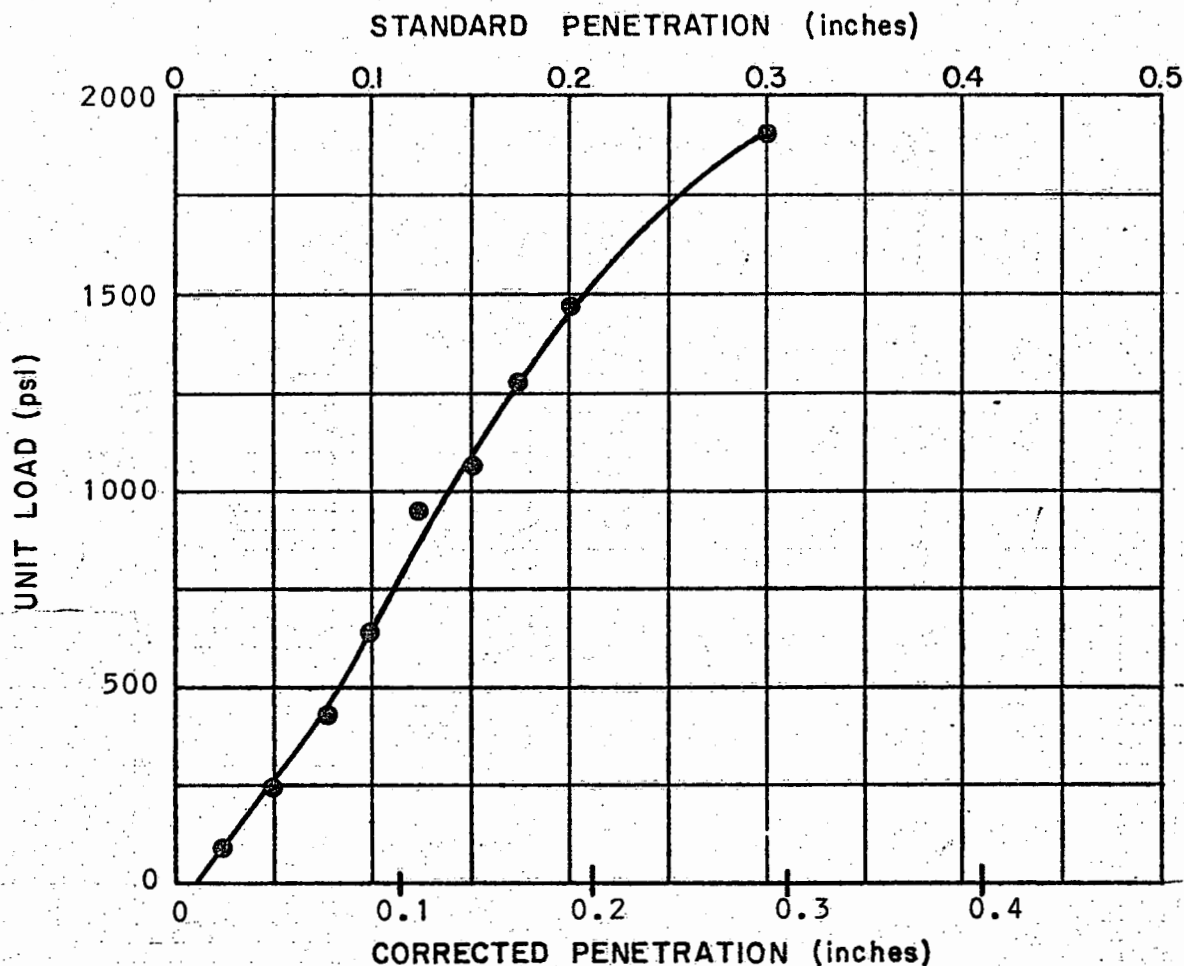
COMPACTION TEST DATA

WESTERN AIRLINES
ALL-PURPOSE FACILITY

Honolulu International Airport

PLATE

17



CBR Test Method: m ASTM D1883-67

Compaction Test Method: ASTM D1557-70(C)

Sample Source: Bulk A; Boring 4,0.0' - 2.0'

Sample Classification	DARK BROWN SILTY GRAVELLY SAND (SM)	
	Before Expansion	After Expansion
Moisture Content (%)	10.1	12.3
Dry Density (pcf)	120	118
CBR Value at 0.1" Corrected Penetration(%)	—	74.0
Percent Swell or Expansion Value(%)	—	0

HARDING - LAWSON ASSOCIATES
Consulting Engineers and Geologists

CALIFORNIA BEARING RATIO
TEST DATA

PLATE

Job No. 3936,005.06 Appr. SS/SC Date 2/26/75

WESTERN AIRLINES
 ALL-PURPOSE FACILITY
 Honolulu International Airport

18